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ABSTRACT

Discussed is a three-week summer workshop-laboratory for teachers and low achievers in mathematics at the secondary level. Teacher planning, small group activities, and the use of electric calculating equipment, mathematically oriented games, and manipulative materials were emphasized. (The amount of time spent in particular activities was measured and is included in the report.) The students were given a pretest-posttest sequence of tests measuring mathematics achievement and self-concept. They also completed a questionnaire. The findings indicated that students showed an average gain of about one half year in mathematics achievement, that their self-concept with regard to mathematics increased significantly, and that none of the students' comments were unfavorable to the workshop as a whole. (Author/CT)

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TEACHER PLANNING + LABORATORY SETTING = AN INNOVATIVE PROJECT

A Summer Workshop-Laboratory for the Low Achiever in Mathematics on the Secondary Level

Emphasis on teacher planning in a mathematics laboratory setting, substituting electric calculating equipment, mathematically oriented games and small group activities for textbooks and classwork, contributed to student success. Observations of a three week summer workshop-laboratory for teachers and low-achieving students, designed by math resource teachers and supervisors of the Montgomery County Public Schools, were conducted by the Department of Research. These observations provided information about what students and teachers did, what their verbal behavior consisted of and how they interacted with each other. Some of the observed results were:

- Electric calculators were the most popular device
- Teacher activities and behavior were adaptive to group size
- Student response was favorable

WHY TRY THE LABORATORY APPROACH?

In 1967, some secondary mathematics resource teachers in the Montgomery County Public Schools participated in a workshop studying available programs applicable to low-achievers in secondary mathematics. They recommended that a summer workshop-laboratory be scheduled in 1968 to:

- Tryout some of the programs for low-achieving students
- Provide in-service training for teachers in math laboratory procedures

Such a workshop-laboratory was set up and the Department of Research participated in the description of the instructional dynamics of the laboratory setting by observing the activities of the teachers and students for the entire

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three week period. The workshop-laboratory effectively combined an in-service teacher training program with new equipment and materials to create an innovative project in the Montgomery County Public Schools.

HOW WAS THE LABORATORY ORGANIZED?

The three-week workshop-laboratory met for two and one half hours, five times a week or for a total of 37 and one half hours. Two sessions were devoted to testing and the remaining 32 and one half hours to instruction. To maintain the teacher-student ratio which would be found in regular math laboratories, teaching responsibilities were rotated among the five teachers participating in the workshop. A different teacher was in charge each day and the others spent their time observing the teacher in charge, planning for future sessions, writing instructional units and circulating through the classroom when the pupils were engaged in small group activities.

All students participants were enrolled in schools in the immediate area surrounding the school where the workshop-laboratory was held because they had to provide their own transportation to and from the school. These students had been earning grades of C or below in mathematics and participated on a strictly voluntary basis.

The observations made by the Department of Research utilized a specially designed time-sampling method. The observations were classified according to the size group in which students were working so that information about influences of group size on instructional patterns would be available.

WHAT WERE THE INSTRUCTIONAL FEATURES OF THE LABORATORY?

The observations show that an outstanding feature of the laboratory was the emphasis on math materials other than the textbook. Textbooks and papers represented only six per cent of the materials used when the class was working as a group. Teacher prepared worksheets represented 27 per cent of the materials used and specific math materials represented 21 per cent. The emphasis on materials other than the textbook became even more obvious when students worked in groups of 7 to 10. Then, they used specific math materials 56 per cent of the time, worksheets 21 per cent of the time and never used textbooks or papers. In fact, for all sized groups of students, some sort of instructional materials were in use an average of 96 per cent of the time the workshop was in session.

The most frequently used math materials when the class was working as a single group were geometric solids (28 per cent of the time) and teacher made arithmetic games (64 per cent of the time). When students were working in small groups, the most frequently used math materials were the calculators. They were used from 15 to 64 per cent of the time when math materials were in use. An

average of 44 per cent of the student activities in all sized groups involved the manipulation of some kind of materials.

Another significant feature of the workshop was the emphasis on small group activity. Students were engaged in individual or small group activities about half of the time (52.8 per cent). There was at least one teacher available to answer questions or help the students during the entire period of small group activities.

WHAT DID THE TEACHERS DO?

The laboratory activities were centered around problem-solving skills which had been identified as the focus of the workshop. Skill in problem-solving was stated as the desired terminal behavior of the student. Each session of the workshop was devoted to teaching a single problem-solving skill or concept.

A considerable amount of planning time preceded the session and it was obviously effective because 92 per cent of the topics covered dealt with math. Planning time was evidently one of the critical factors in the success of the workshop because it gave teachers time to organize the lessons in depth. Problem solving was emphasized in student activities 25 per cent of the time. No other skill was emphasized nearly as frequently. The two next most frequently emphasized skills were dealing with information (17 per cent of the time) and reasoning and logical thinking (11 per cent of the time).

During the laboratory sessions teachers spent over 51 per cent of their time motivating, evaluating and reinforcing student learning. In contrast, they spent only 39 per cent of their time developing students' skills and math concepts. Observers in the workshop noted that teachers seemed to encourage students to work more in areas in which the students were interested than in predetermined areas.

Teacher verbal behavior differed with group size, indicating that each sized group had its own particular function. The most desirable group sizes from an instructional point of view were groups of seven to ten students and students working on an individual or one-to-one basis with the teacher. In these group sizes the teachers were more frequently explaining, clarifying, discussing and answering students' questions. When the entire class was together, the teachers spent 29 per cent of the time asking questions with a predicted answer, that is, questions with only one correct answer. Teachers tended to evaluate student work more frequently when working with students on a one-to-one basis and to give assignments and directions to the entire class or to groups of 11 or more.

HOW DID STUDENTS CHANGE?

The first and last days of the workshop were devoted to testing. Each student was given two batteries of tests – a standardized achievement test and a specially constructed "Self Concept Test." In the case of the achievement test, the

students showed an average gain of about half a school year between the first and last days of the workshop-laboratory.

The "Self Concept Test" was developed in the Division of Psychology of the Montgomery County Public Schools. This test was constructed to see if a series of success experiences would increase the students' expectancy of success in a subject area. The students' scores on the post-test were significantly higher for the subject area of math than on the pre-test while there were no differences of any significance in the other subject areas. This suggests that at the end of the workshop the students felt more confident of their ability to face and solve math problems.

As a final measure, students were asked to complete a questionnaire and record how they felt about their workshop experience. None of the comments made by the students were unfavorable towards the workshop as a whole. Here are a few of the comments made by the students.

"I enjoyed the workshop and the people that ran it very much. At times I found it easy, and at other times a challenge. If there was another workshop like this next summer, I would take it."

"I think I will be able to understand fractions and decimals better."

"It was a very enjoyable three weeks and I'm sure I improved my math skills."

"I enjoyed it very much and I learned more about math."

SUMMARY OF FINDINGS

The math workshop-laboratory may be considered a success in terms of student reponse and teacher planning. Its success has implication for the development of new instructional settings and practices in mathematics education and for further research.

- The mathematics laboratory was an instructional setting where the major student activity consisted of manipulating mathematics materials and special equipmentt.

- Both teachers and students benefited from the increased time allowed for planning through better organization of lessons.

- Observations revealed that the most desirable group size for laboratory type instruction is seven to ten students interacting with a teacher and among themselves.

- The in-service training for teachers provided an opportunity for teachers to develop skill in motivating, evaluating and reinforcing student learning.